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## ABSTRACT

Specifically this paper discusses how information technology can strategically support the Air Command and Staff College (ACSC) classroom of the future. The following methodology is used to accomplish this thesis. First is a general discussion of how IT should be used not to just automate processes, but to improve the strategic position of the organization. The next step is to understand what the school's mission and goals are currently and how they are expected to change by the year 2001. With this foundation, then a snapshot of the present use of I/T to support classroom operations at ACSC is presented. Finally, once the strategic mission is understood, specific technology that can support this mission is presented along with an implementation methodology.

The conclusions reached are that the school needs to shift its focus from primarily using information technology (I/T) as a way to automate existing processes to developing an I/T plan that comes from, and thus supports, the unit's goals and objectives. Areas such as senior leadership commitment and support, operational leadership in the development of I/T plans, finding an I/T champion, effective I/T project leadership, and fostering a culture that nurtures the strategic use of I/T must be addressed if the successful merging of organizational and I/T strategies is to occur.

After analyzing the unit's goals and objectives in light of future environmental factors, it becomes apparent that Intelligent Tutoring System (ITS) technology would strategically support the needs of the organization. ITS technology is a strategic enabler for ACSC.

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**RANK:** Lt. Col.

**SERVICE BRANCH:** USAF

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USING INFORMATION TECHNOLOGY TO  
STRATEGICALLY IMPROVE THE FUTURE  
CLASSROOM OPERATIONS AT THE AIR FORCE'S  
AIR COMMAND AND STAFF COLLEGE

BY  
Jeffrey Hukill

## TABLE OF CONTENTS

<b>TABLE OF CONTENTS.....</b>	<b>2</b>
<b>LIST OF TABLE AND FIGURES .....</b>	<b>3</b>
<b>INTRODUCTION .....</b>	<b>4</b>
<b>THE STRATEGIC USE OF INFORMATION TECHNOLOGY: THE FIRST LAYER.....</b>	<b>5</b>
ALIGNMENT OF BUSINESS AND I/T STRATEGIES.....	5
HOW TO SUCCESSFULLY INTEGRATE ORGANIZATIONAL AND I/T STRATEGIES .....	9
<b>USE OF I/T AT AIR COMMAND AND STAFF COLLEGE: THE SECOND LAYER .....</b>	<b>12</b>
ACSC DESCRIPTION AND MISSION .....	12
ACSC ORGANIZATIONAL STRUCTURE .....	15
ACTUAL USE OF I/T AT ACSC .....	16
PROBLEMS WITH I/T PLANNING AT ACSC .....	18
CHANGING DOMAIN OF ACSC BY THE YEAR 2000.....	22
<i>Economic Driven Changes.....</i>	22
<i>Changing Air Force Requirements .....</i>	23
Educate Every Field Grade Officer.....	23
Tailoring Education To Individual Needs.....	24
Teaching Network Computer Skills.....	24
<i>Lack of Domain Expert Instructors.....</i>	25
<b>MATCHING ACSC MISSION/GOALS WITH I/T CAPABILITY: THE THIRD LAYER.....</b>	<b>27</b>
DESCRIPTION OF INTELLIGENT TUTORING SYSTEMS .....	27
INTELLIGENT TUTORING SYSTEM ARCHITECTURE .....	30
<i>The Expert Knowledge Component.....</i>	30
<i>The Student Modeling Component.....</i>	31
<i>Tutorial Planning Component .....</i>	32
<i>Communication Component.....</i>	33
ENABLING TECHNOLOGY FOR ACSC .....	33
<i>Teach More Officers on an Individualized Basis.....</i>	33
<i>Less Money Available, Less Time to Teach.....</i>	34
<i>Distance Learning.....</i>	35
<i>Teach at the Application, Analysis, and Synthesis Levels of Learning .....</i>	36
<i>Making Students Computer Comfortable.....</i>	36
RECOMMENDATIONS FOR IMPLEMENTATION OF AN ITS AT ACSC .....	37
<i>Organizational Goals and Objectives:.....</i>	39
<i>Select Appropriate I/T.....</i>	39
<i>Restructured Teaching Processes .....</i>	40
<i>Curriculum Structure .....</i>	40
<i>I/T Infrastructure Development.....</i>	41
<i>Lesson Development .....</i>	41
<i>ITS Development.....</i>	41
<i>Non-ITS Lesson Development.....</i>	43
<b>CONCLUSION .....</b>	<b>44</b>
AREAS FOR FUTURE RESEARCH.....	44
<b>REFERENCE LIST.....</b>	<b>46</b>

<b>APPENDIX A: I/T CAPABILITIES AT ACSC.....</b>	<b>48</b>
<b>APPENDIX B: NETWORK DESCRIPTION.....</b>	<b>50</b>
HARDWARE CONFIGURATION.....	51
SOFTWARE.....	53

## LIST OF TABLE AND FIGURES

FIGURE 1: PAPER METHODOLOGY.....	4
FIGURE 2: INTERACTION BETWEEN ORGANIZATIONAL GOALS AND I/T PLANNING .....	8
FIGURE 3: LEVELS OF LEARNING.....	13
FIGURE 4 TYPES OF INSTRUCTIONAL METHODS USED .....	14
FIGURE 5: ACSC ORGANIZATIONAL STRUCTURE .....	15
FIGURE 6: I/T PLANNING PUSHING ORGANIZATIONAL GOALS .....	19
FIGURE 7: ACSC CURRICULUM GOALS AND DOMAIN PROBLEMS .....	26
FIGURE 8: CAI vs. ITS .....	29
FIGURE 9: ITS ARCHITECTURE .....	30
FIGURE 10: ITS AN ENABLER FOR CHANGE .....	37
FIGURE 11: IMPLEMENTATION METHODOLOGY .....	38
FIGURE 12: NETWORK DIAGRAM .....	50

## INTRODUCTION

Specifically this paper discusses how information technology can strategically support the ACSC classroom of the future. The following methodology is used to accomplish this thesis. First is a general discussion of how IT should be used not to just automate processes, but to improve the strategic position of the organization. The next step is to understand what the school's mission and goals are currently and how they are expected to change by the year 2001. With this foundation, then a snapshot of the present use of I/T to support classroom operations at ACSC is presented. Finally, once the strategic mission is understood, specific technology that can support this mission is presented. The methodology mentioned above is displayed in Figure 1 below. The subject is broken down into three layers. Each layer must be understood, starting with the outer layer, before moving to the next layer as each layer builds upon the next.

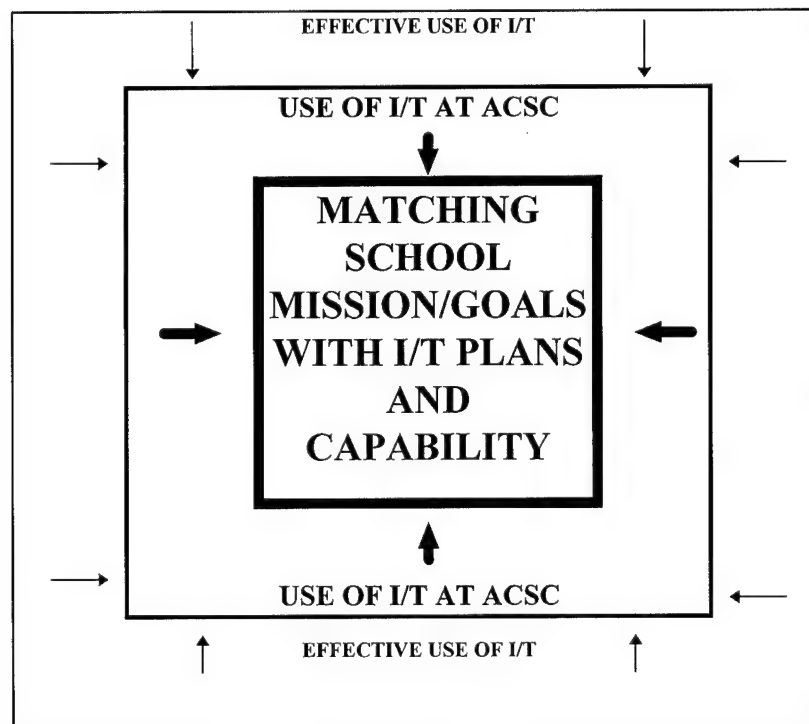


Figure 1: Paper Methodology

## **THE STRATEGIC USE OF INFORMATION TECHNOLOGY: THE FIRST LAYER**

The first step in this analysis is to understand the best way to use I/T in order to gain the greatest benefit. This is a critical first step because despite significant expenditures on I/T, a search of current literature shows that I/T has not lived up to its promised potential. Michael Hammer said it best "...heavy investment in information technology have delivered disappointing results" (Hammer, 1990, p104). The problem with a significant amount of I/T expenditures is that it is spent to automate existing process rather than support an organization's strategic plan. Using I/T in this manner does not unlock the true potential of I/T and leads to unfulfilled promises. The problem with mechanizing old ways of doing business is that although it may increase the efficiency of certain parts of the organization, it does not significantly impact the overall business strategy. The best results from I/T use are obtained when it is incorporated with the strategic vision of the organization. Its use can provide strategic value to all parts of the organization. The objective of I/T should not be to merely solve the operating problems of a particular department, rather as Luftman et al., suggest an organization should focus on how I/T can strengthen the strategic performance of the enterprise: "...organizations should be thinking about competing power, not computing power." (Luftman, Lewis & Oldach, 1993, p. 203).

### **Alignment of Business and I/T Strategies**

The strategic use of information technology is a fundamental issue for every organization. If used correctly I/T can change the basic nature of a group. The effective and efficient utilization of information technology requires the alignment of I/T strategies with business

strategies. Often, too much attention is placed on technology, rather than business, management, and organizational issues. The objective is to build an organizational structure and set of processes that reflect the interdependence of enterprise strategy and information technology capabilities. The attention paid to the integration of information technology and the enterprise can significantly affect the value to be gained from technology. The essential issue is how information technology can enable the achievement of positive strategic change within the organization.

In the business world I/T has transformed the basic nature of many industries. I/T is enabling business processes to be redesigned in ways that were previously thought impracticable or impossible. Some examples of the competitive application of I/T are listed in Table 1.

Ensuring

DISTRIBUTION	- Notebook/palm-top computer-based processing enhances just-in-time (JIT) product delivery and market analysis
EDUCATION	- Computer-assisted instruction for individual education and training - Multimedia sessions for whole group learning - Worldwide network linking students, leading educators, and researchers
FINANCIAL SERVICES	- Automated teller machines support 24-hour banking services - Automated teller machines offer non-financial services (e.g. travel reservation) - Electronic Funds transfer is eliminating the need for traditional checks - Imaging systems automate handwriting recognition and reduce paper usage - Knowledge-based systems speed credit authorization or claims adjudication reviews
MANUFACTURING AND ENGINEERING	- Specialized applications such as computer-aided design and manufacturing (CAD/CAM), computer-aided engineering (CAE), computer-integrated manufacturing (CIM), and materials requirements planning (MRP)
RETAIL	- Point-of-sale terminals provide faster customer checkout, measure customer preferences, and automate just-in-time inventory control
TRAVEL	- Reservation systems provide current information to agents and travelers; they also assist in analyzing demand and altering prices

**Table 1: Representative Examples of Contemporary, Competitive Applications of I/T (Luftman, Lewis, & Oldach, 1993, p. 201)**

that the enterprise is effectively and efficiently using its I/T resources is essential for success.

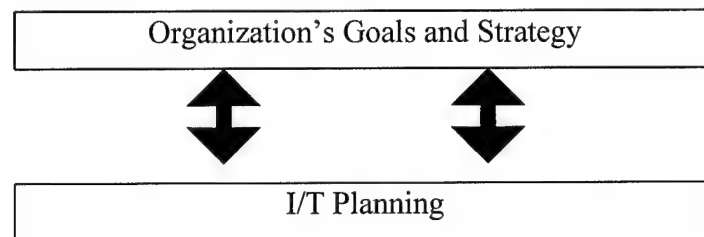
For organizations to succeed in an increasingly competitive, information intense, dynamic

environment, the alignment of business strategies and information technology strategies is a necessity. These strategies are in alignment when the organizations objectives are enabled, supported, and simulated by information technology strategies. The importance of linking these two strategies can be seen based upon the result of a survey of top senior business executives. The need to link an organization's strategies with I/T strategies consistently ranks among the top two objectives of senior business executives within the information technology function (as reported from IBM's Advanced Business Institute customer executive surveys) (Luftman, Lewis, & Oldach, 1993).

Using I/T for strategic improvement implies the application of I/T to enable strategies that enhance the critical success factors and/or core competencies of the organization. Here, information technology can be used to support the organization in achieving its objectives. For example, systems and technical infrastructure or architecture are in place to support the business by providing the opportunity to compete, improve productivity and quality, and enable new ways of managing and organizing (Luftman, Lewis, & Oldach, 1993). Strategic improvement is represented by the ability of the I/T function to affect the choices that determine the infrastructure and processes of the organization to run the business better. I/T can also be used to improve your competitive position (accomplish your mission better than anyone else) by being a proactive contributor to mission-critical systems (Luftman, Lewis, & Oldach, 1993). Here, information technology can be used to create new marketing opportunities.

An important aspect of strategic alignment is that it is not a one time event. It is a continuous process that must adjust and adapt to the changing environment. Your organization's strategic mission and goals must adjust to change, thus your I/T strategy should constantly

change in concert with your business strategy. Changing your business strategy without changing your I/T strategy to support it could cause failure, just as applying I/T to old, ineffective, inefficient business processes will not create business value. The key point is that it is not the information technology itself that will create value, but the business processes that exploit the technology. The analysis of processes for opportunities or problems should precede carrying out I/T strategy and planning methods. Also it is just as important to analyze strategies for I/T opportunities, before the actual re-engineering of business processes occurs. Figure 2 illustrates that the goal is to interact between the two strategies in order to create synergism between them, resulting in improved strategic operations for the enterprise.



**Figure 2: Interaction Between Organizational Goals and I/T Planning**

Although the enterprise typically has a clear business strategy, it often lacks a coherent information technology strategy or direction for infrastructure and processes. More often, if organizational, I/T, and infrastructure strategies exist, they fail to relate to one another. Frequently I/T strategies and plans are prepared using the following thinking (Luftman, Lewis, & Oldach, 1993, p. 206):

- Basing I/T strategies and plans purely on technology
- Changing I/T infrastructure and processes without linkages to the enterprise
- Creating business strategies and plans without I/T participation
- Improving old processes by simply applying technology which result in only short term benefits
- Not creating I/T strategies at all
- Transforming organizational infrastructure and processes without I/T involvement

Recognition of the strategic role that I/T can have is driving the need to ensure that future strategies and plans are not developed by one of the ways mentioned above. Meeting the objective of linking organizational and I/T strategies requires a shift of interest from technological considerations to examining organizational change to obtain improved strategic operations. Business objectives must be well-supported and stimulated by information technology strategies and capabilities.

### **How to Successfully Integrate Organizational and I/T Strategies**

The following are several of the key concepts that have been followed by organizations that have completed, implemented and maintained I/T that reflects linkage to the organizational strategy

Management Commitment and Support: This leads every success factor list -- the necessity to obtain adequate funding and gain creditability. Both the I/T and business areas must discuss and agree on a common vision. Presentations should explain the concepts, vision, and mission in a manner that virtually assures management commitment and support ( Spewak, 1992, p. 32).

Operational Leadership: Operational leadership is an absolute requirement for developing strategically enabling I/T. Operational is defined as the primary purpose an organization exists. For example the operational leadership of a manufacturing firm are the personnel directly associated with the making of the product the company sells. The problem has been that most projects have been delegated to the information technology community because the operational community has been convinced that it can't possibly understand information

processing or have the time to figure it out. Operational leadership for strategic I/T development is a must because the business leaders are the best ones to understand the true information and processing needs of the enterprise. Melissa Cook (1996, p. xix) describes it quite simply,

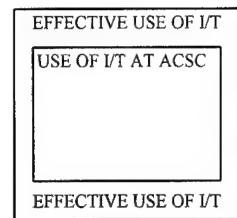
The information technology community is obviously a critical partner in building an integrated information architecture. But would you put one of your contractors in charge of the architectural drawing for your new office building? Of course not. You would hire an architect to design the architecture. You would also hire contractors and trust them to select the appropriate tools and materials based on their expertise and experience and encourage them to give the architect advice about potential architectural changes that would make it easier to build the building.

Champion: This is a person in an organization that is a strong advocate or defender of I/T projects (Carr, 1993, p. 139). The champion needs to be able to inspire project team members and generate support from various affected organizations. Champions are critical to the successful outcome of an I/T project because they ensure continued senior management support. It does not matter if the champion comes from either the business or I/T side of an organization. What matters is that they are respected and listened to (due to job position and personal skills) by senior management and constituents from the organization. All I/T projects will run into bumps in the road. It is the champion's job to smooth out the bumps in order to keep senior management interested and involved with the project.

Effective Project Leadership and Workplan: Successful integration plans have occurred when leaders adopt a methodology, develop a clear and concise workplan that is easy to follow, and motivate and guide integration efforts through to conclusion. The methodology itself is not the success factor, but any methodology is better than none. It is the ability of the project leader

to manage the process that is key to success, and a good leader has a good workplan. ( Spewak, 1992).

Compatible Culture: “A correct corporate culture is the basic foundation to successful integration of business and I/T strategies” ( Spewak, 1992, pg. 34). The values of a firm’s senior management, the firm’s approach to corporate planning, its philosophy of control, and the speed of technological change in its core products all influences how I/T should be used. (Cash, & McFarlan, & McKenny, & Applegate, 1992). The right culture makes it easier for both business and information systems personnel, user, management, and staff to support integration.



## **USE OF I/T AT AIR COMMAND AND STAFF COLLEGE: THE SECOND LAYER**

Now that a general discussion of how the planning for and use of I/T should be driven by and integrated with the organization's overall strategy, the next step is to understand how I/T is actually planned for and used at ACSC. In order to understand the use of I/T at ACSC a brief description of the school's mission, goals and I/T capabilities is provided.

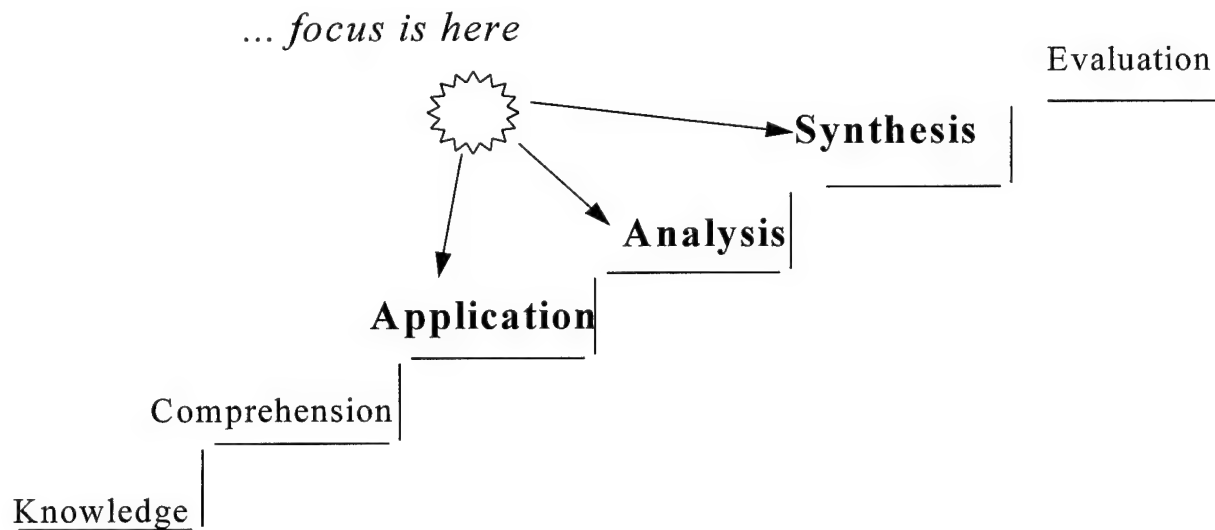
### **ACSC Description and Mission**

ACSC is an Air Force intermediate service school with annual resident and distance learning programs. The staff is composed of approximately two hundred faculty members; three quarters of whom are line instructors involved in full or part-time curriculum development, instruction, and research support. The majority of the teaching faculty are resident graduates while the remainder are hand-picked area specialists. The remaining 75 staff members fill support roles in administration, finance, supply, and technology support. The academic environment is designed to stimulate and encourage free expression of ideas, as well as independent, analytical, and creative thinking. According to the ACSC unit mission brief, the mission of the school is:

A world-class team educating mid-career officers to lead in developing, advancing, and applying air and space power across the spectrum of service, joint, and combined military operations (ACSC Unit Mission Briefing, 1996, slide 3).

This mission is accomplished by instilling in the students an understanding of the development, advancement and application of air and space power. First, air mindedness is developed in the

600 multi-service and international field grade officer students to assist in developing a richer understanding of air and space power. Additionally, critical thinking is stimulated by the use of case studies, research projects, and wargaming to engender the ability to develop, advance, and apply air power solutions. Finally, throughout the year there is a strong focus on leadership potential. The goal is to achieve the application, analysis, and synthesis levels of learning (Figure 3). A variety of instructional methods are used in order to reach these goals. They consist of self directed learning, seminar classes, application, and expert lecture with an eye towards active



**Figure 3: Levels of Learning**

learning (Figure 4). The ACSC instructor teaches approximately one third of the total curriculum.

*... with an eye towards **active learning***



**Figure 4 Types of Instructional Methods Used**

When they are “in phase” (actually in the classroom teaching) the instructors, will teach two to three different classes (different subject matter) a day, twice a day (the school is on an AM/PM schedule). During the ten month course the instructor teaches a broad range of subjects resulting in a need for breadth of expertise.

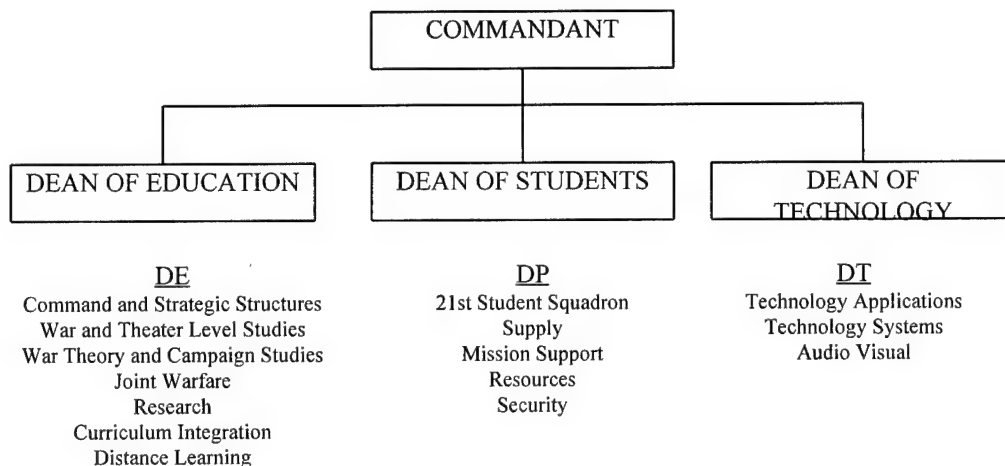
The annual resident program is ten months long and consists of approximately six hundred students broken down into 44 seminars of 14 students each. The FY 97 student population consists of 387 Air Force officers, 80 international officers, 90 Army, Navy, and Marine officers, 25 Air National Guard and Reserve officers, and 19 DOD civilians.

The curriculum is book and technology based. Book based means each student is given approximately 100 books that are used to explore the works of many great thinkers and strategists, both military and civilian. Technology based means that the use of information technology is pervasive throughout the curriculum. Appendix A shows a detailed listing of the I/T available to each instructor and student and Appendix B shows a network architecture

diagram. The most notable elements of the I/T architecture are, each student is issued a 486DX-33MHZ or Pentium laptop computer to use to synthesize information obtained during seminars, lectures, readings, and research. In addition, each student has a LAN connection available to them at their desk from which they can reach anywhere throughout the school or the Internet. Each seminar room has a multimedia Pentium PC computer with 17 and 25 inch video monitors, color scanner, and laser printer.

### ACSC Organizational Structure

ACSC is commanded by a Commandant and is divided into three major directorates as represented in Figure 5. The faculty members are led by the Dean of Education (DE). The



**Figure 5: ACSC Organizational Structure**

education directorate is made up of 7 divisions. The Dean of Technology (DT) is responsible for three divisions. The technology directorate is on equal footing, organizationally, with the teaching directorate.

## **Actual use of I/T at ACSC**

Technology has become an active part in the presentation of the ACSC curriculum. However, an active part does not mean a totally effective element of the curriculum. The question that needs to be addressed when looking at the integration of I/T in the ACSC curriculum is, does it support the mission of the school?. In other words, is I/T planned for and used to enrich the learning process? Does I/T support critical, independent, analytical, and creative thinking and, allow learning to be conducted at the application, analysis and synthesis levels, or does I/T just automate the way current teaching is done making it more efficient but not more effective? Based upon my personal knowledge of the organization when assigned at the school and based upon recent interviews of faculty members and students, for the most part I/T is used more to automate the teaching process rather to enrich it. This under-utilization of the true benefits of I/T come as a result of a mismatch between organizational objectives and I/T objectives. Several examples should help to explain this conclusion.

The LAN is used extensively to disseminate information to students. For example, class schedules, lessons plans and student critiques are disseminated through the network. This type of material was previously distributed via paper copy so the information the student is getting is the same. The information is just delivered in a more timely and efficient manner. The recent use of HTML software to develop the student schedule with hypertext links between the schedule and lesson plans for the subject is extremely efficient and useful but still does not directly enrich the learning environment. Some of the hypertext links do include web sites that contain information pertinent to the lesson. This is potentially an enriching use of I/T if the information is actually incorporated into the classroom curriculum.. This increased efficiency in the

distribution of information is good and should be done but, it does not unleash the true potential of I/T. It also does not entail a strategic use of I/T.

Another example deals with an area where the school has attempted to use I/T to impact the learning environment. Multimedia presentations have been developed using software applications developed with Toolbook. The theory behind the use of these Toolbook applications is to provide lessons on knowledge level information so that classroom learning can take place at the analysis or higher levels. This idea is on-track as far as changing the learning environment but falls short of its potential due to the nature of the Toolbook applications. Most of the Toolbook applications are not rich in multimedia content. The majority of them are just electronic versions of the books that the material was taken from. This electronic version of the book ends up being harder to read on the small laptop screen than it would have been in the original printed version. Thus, the applications become electronic "page turners". In addition, most of the laptops are not CD or sound equipped so that even if there is a lot of video and audio included in an application the student would not be able to benefit from it (recent upgrades to Pentium laptops with CD and sound is partially fixing this problem). Also, many of the Toolbook applications are not focused to support a specific lesson. They are very broad in scope which makes them more useful as a reference source rather than a tool to support the learning of specific objectives of a specific lesson. Instead of enriching the learning process, these large, unfocused Toolbook applications end up stifling the transfer of knowledge. This occurs because as the students read their 50 to 100 pages a night to prepare for the next day's lessons and then attempts to "read" the Toolbook application, they become overwhelmed. Students have stated

that they felt there was more value in the books so they would read them and neglect the Toolbook application.

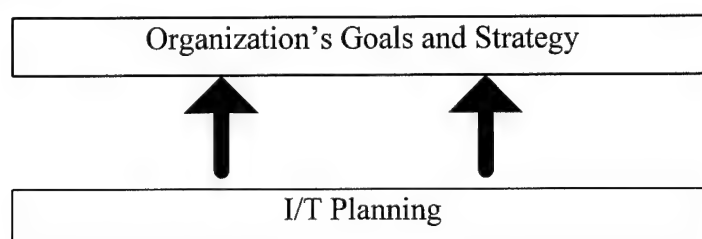
Still another example deals with the use of e-mail to send questions to a guest lecturer from faculty members who are not able to attend a lesson due to the seating capacity in the auditorium when the entire student body is present. The faculty can watch the lecture in their offices via closed circuit TV and send e-mail questions to a moderator who can then relay the question to the speaker. Again this is an innovative use of the LAN/e-mail and should be continued but it only makes the questioning process more efficient. The same type of moderator system could have been done with the use of phones or even a runner. The use of I/T in this case is innovative, but does not strategically impact the learning environment.

These examples are representative of how I/T is presently used in support of the ACSC curriculum. This is not to say that there are not cases where I/T is used to enrich the curriculum rather than automate the support of it. However, the examples where I/T was used to enrich the course are isolated and not a critical part of the entire 10 month process. So, the next question to be answered is why the use of I/T to enrich the program is not more pervasive throughout the entire school.

### **Problems with I/T Planning at ACSC**

As described above and in Appendix A and B the I/T capabilities at ACSC are significant and the use of I/T is widespread throughout the school but, why is it not used in a more strategic way? The answer to this question is simply that there is no real integration between the educational mission/goals and the I/T mission/goals. As stated earlier the mission of the school

is to develop critical, independent, analytical, and creative thinking and, to conduct teaching at the application, analysis and synthesis levels of learning. Any procurement of I/T for the classroom should be done with these objectives in mind. However, rather than starting with these objectives, then developing an I/T plan to support them, it seems that I/T capability is purchased then the faculty decides on how they can use it. In other words I/T is pushing the decision on how technology should be used rather than flowing from the organizational objectives (see Figure 6).



**Figure 6: I/T Planning Pushing Organizational Goals**

The roots of this problem can be traced back to 1992 when much of the I/T capability was first purchased. The funding for the LAN and individual student laptops came so quickly it did not allow for much planning. In the expenditure budget environment, the money had to be spent or would be lost. This resulted in most of the I/T capability being decided upon by the technology people with only general discussions with the using faculty. The result was the notion that the school should buy the capability now and figure out how to best utilize it later. This lack of integrated planning has continued as evidenced by the following example. The Technology Directorate (DT) recently developed a fairly detailed I/T requirements plan. The plan lists requirements for upgrades to the LAN, improved multimedia capabilities in the classroom, video conferencing , and electronic whiteboards. However, this planning was done from only a technology directorate perspective. Little or no coordination was done with the Educational

Directorate (DE) during the development of the plan. A few people knew that the plan was being worked on, but no one knew what the plan included. While improving multimedia capability is beneficial, if the faculty has not decided to strategically incorporate this type of technology into the classroom then it may become wasted capability. For this type of disjointed planning blame can be found throughout both directorates and with the senior leadership of the school. All parties involved with the use of and planning for I/T must recognize that the problem of poor integration exists before they can take corrective action.

As mentioned in section one there are five areas if addressed successfully lead to integrated organizational goals with I/T planning pay resulting in the strategic use of I/T. In the next section those five areas are applied to ACSC.

Management Commitment and Support: Senior management must take an active role in establishing the priority for organizational and I/T objective integration. They must make it clear that it is a top priority and continue to follow-up on its progress.

Operational Leadership: The education directorate must be the driving force in setting the vision on how I/T should be used in the classroom. Failure to do this creates a void that will be naturally filled by the technology division. This will result in unilateral I/T purchasing decisions that DE will have to adapt to and live with.

Champion: Also a champion must be found who is able to ensure that the integration of organizational objectives and I/T objectives stays on-track and that senior leadership involvement does not wane.

Effective Project Leadership: . Since DE is responsible for the operational mission of the school, they must head the planning and implementation teams. They need to supply the I/T

architects with the specific goals and objectives on how to strategically use technology in the classroom. In other words, they need to instill the vision with the project teams of how the teaching process can be improved upon and then interact with the I/T personnel to implement specific solutions. Currently, isolated individual ideas on how to use the technology are bubbling up from the faculty. The idea that led to the development of the HTML schedule is an example of this. Individual innovation should be encouraged but it should not be the primary planning tool. In DE's case, it seems to be the de facto planning tool.

Corporate Culture: Senior leadership must develop the environment within the school that encourages the use and development of I/T assets. The school personnel are very technologically aware. The numerous computers available throughout the school and the use of the computers to access schedules and send/receive e-mail has made most faculty and students comfortable with I/T. However, the culture needs to shift from use of I/T for automating existing processes to thinking about how I/T can be used strategically, to further the schools mission.

Up to this point, most of the focus has been on the current time period. Before continuing with the next step of matching organizational objectives to specific technology recommendations, the area of the future environment must be discussed. Since one of the objectives of this paper is to make recommendations that would be applicable in the next five years, an environmental scan must be done in order to determine what factors will influence the way future classroom operations are conducted.

## **Changing Domain of ACSC by the year 2000**

Along with understanding how ACSC operates currently, it is also important to look at expected future changes in order to develop realistic organizational objectives so that I/T plans can be developed to match them. Two recent research projects have been completed which identified expected changes in the operation of professional military education. The main drivers of the change are economic, changing Air Force requirements, and a lack of qualified instructors. Each of these driving factors is elaborated on next.

### *Economic Driven Changes*

Military budgets, as a percentage of real GNP, will continue to get smaller in the future (Spacecast 2020, 1994, p. L-5). There will be less money spent on travel than now. This infers fewer Permanent Change of Station (PCS) assignments to attend Professional Military Education (PME) and other specialized training. This means that the current ten month residence program (a PCS) will be shortened to no more than 180 days (making it a TDY) with the rest of the course being taught through some type of distance learning program. This change would save the Air Force a substantial amount of personnel and moving costs.

In addition the reduced budgets will mean less money to hire civilian Ph.D. qualified staff (experts) and less money to help "grow" experts by sending active duty AF personnel to school to obtain Ph.D.'s or recent Master Degrees. This loss of expertise will severely hurt the credibility of the school since a large part of the curriculum is taught in seminars by individual instructors. Even though the residence portion of the course will shrink to 180 days,

approximately the same number of qualified instructors will be needed because more than one class a year will be sent to the school.

In addition, the budget cuts will impact the ability to purchase the approximate 100 books per student the current curriculum now requires. With the loss of the books which form the foundation for the course, alternatives to the books must be found or the course must be radically restructured.

### *Changing Air Force Requirements*

The Air Force Senior Staff has told the leaders of all PME that several changes will have to be made by the year 2000 in order to make all the courses more effective in meeting the service's future needs. Three of the changes that will impact ACSC the most are the need for the residence curriculum to touch more officers, the need to tailor education to individual needs, and for the curriculum to teach the students to be comfortable using computers in a networked environment (Spacecast 2020, 1994, p. L-8).

### Educate Every Field Grade Officer

The Air Force's PME must educate every military officer. The reason for this philosophy is summed up in a statement from Tom Peters in his book *Thriving on Chaos*, we must: 1) invest in human capital as much as in hardware, 2) train entry-level people and then retrain them as necessary, 3) train everyone in problem-solving techniques to contribute to quality improvement, 4) train extensively following promotion to the first managerial job; then train managers every time they advance, and 5) use training as a vehicle for instilling a strategic thrust (Peters, 1991, p. 386).

This need to have a better-educated and trained force requires all military personnel receive their education and training through a quality PME system. ACSC will be able to offer more in-residence classes since fiscal constraints are going to force them into shorter course lengths allowing for more than one class a year. Since the remainder of the course will be presented through a distant learning program, this program will be almost as easy to conduct for five officers as it would for 50 since the same technology put into place for the five will be the same for 50. The vision is for the ACSC students in the non-residence phase to continue the "seminar" experience through "on-line" seminars and virtual residency. Virtual seminars will initially meet via video teleconferencing centers at their home units. All groups in the ACSC system can share in these on-line seminars.

#### Tailoring Education To Individual Needs

Future ACSC curriculum will need to be an individualized, self-modifying education system responding to the learning modes of each student (Spacecast 2020, 1994, p. L-8). Faculty will be able to concentrate on instructing at higher levels of learning and developing courses for entirely new areas of instruction. Specialized training will be provided for systems specifically needed to accomplish the requirements of the next assignment of the student. Individuals trained in this environment will have the flexibility to be stationed wherever needed and know the job requirements or be capable of learning them quickly.

#### Teaching Network Computer Skills

As a result of Desert Shield/Storm, the U.S. military has learned that computers are a necessity in all aspects of military operations. The Air Force discovered that the computer skills

of many field grade officers involved in planning the Air Campaign were weak at best. As a result, the Chief of Staff of the Air Force directed ACSC to beef up these skills so that graduates will be able to operate these machines and share knowledge among widely dispersed units via computer networks. These skills will be vital for the successful outcome of future air campaigns.

#### *Lack of Domain Expert Instructors*

The instructor problem began in 1994 when the ACSC curriculum changed to a college graduate style program and is expected to grow in the future. The instructor now teaches in a seminar much like a regular college professor (the ACSC instructor used to be a facilitator rather than an instructor) and to be credible they need to be the expert on all the subjects they are teaching. To become an expert usually requires time and training. The problem is that faculty duty is normally only for two years and the instructors are selected from graduating classes of ACSC. Most of the new instructors do not have Ph.D. credentials. This type of situation does not allow for the development of true domain expertise. In the past civilian Ph.D. qualified instructors were hired and several AF faculty members were selected to get Ph.D.'s or current masters degrees to provide a solution to the problem of rotating instructors without in-depth domain expertise. These types of programs could be in jeopardy due to budget reductions.

In addition, it is hard to develop true expertise in all of the diverse subjects the instructor will teach during the school year. The range of subjects an ACSC instructor teaches would be equivalent to an Instructor in the School of Business of a major university teaching macro-economics, management theory and principles of marketing. This broad range makes it hard to

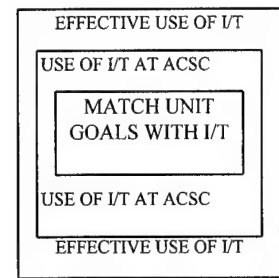
develop in-depth expertise. If ACSC wants to continue its graduate style program, it must address how to develop ways to compensate for the domain expert instructor shortage.

Figure 7 summarizes ACSC's key curriculum goals and domain problems, both currently

Mission
<ul style="list-style-type: none"> <li>- The academic environment is designed to stimulate and encourage free expression of ideas, as well as independent, analytical, and creative thinking</li> <li>- Teach students at the application, analysis, and synthesis levels of learning</li> </ul>
Economic Driven Changes:
<ul style="list-style-type: none"> <li>- Shorter Residence Course</li> <li>- Need for more distance learning courses</li> <li>- Less money for the hiring of civilian PhD instructors or educational training of AF instructors</li> </ul>
Changing Air Force Requirements
<ul style="list-style-type: none"> <li>- Educate all field grade officers</li> <li>- Individualized instruction</li> <li>- Teaching network computer skills</li> </ul>
Lack of Domain Expert Instructors

**Figure 7: ACSC Curriculum Goals and Domain Problems**

and in the future. The gist of this is that ACSC must teach more officers, more material, on an individualized basis, in a shorter period of time with less money through in-residence and outreach courses.



### **MATCHING ACSC MISSION/GOALS WITH I/T CAPABILITY: THE THIRD LAYER**

Now that an explanation of the ACSC domain has been completed, it is time to apply the principles outlined in the first section. The focus of this effort should be to look for technologies that will support the stated goals/objectives and the projected changing environment of ACSC listed in Figure 7 above. The important point to remember is that the technology must be an enabler for true process change in order to gain the most effect from the equipment and to gain the most from the investment. The idea is not to solely automate existing processes within the teaching operations. The focus should be to strategically change the teaching operations with technology as an enabler in order to achieve the organization's goals in a changing environment. After reviewing the items listed in Figure 7 and also reviewing literature on various teaching technology, the most promising type of enabling I/T for ACSC is the use of Intelligent Tutors.

#### **Description of Intelligent Tutoring Systems**

In order to understand why an Intelligent Tutoring System (ITS) is an enabling technology for ACSC it is necessary to first explain what an ITS is and how it works. An ITS, which is a type of Electronic Performance Support System (EPSS) is probably best described by contrasting it with a traditional computer aided instruction (CAI) system. A CAI system is an automated presentation device for material generated by an author (Elsom-Cook, 1990, p7). In the 1960's there was a movement towards "programmed learning" in education. This was an approach based upon Skinnerian methods (Skinner was a behavioral psychologist whose theories

developed in the 1950's greatly influenced teaching theories many of which are still in use today), in which a domain was reduced to primitive chunks that could be taught to a pupil individually. Any one chunk was a prerequisite for other chunks, and the original chunk could have prerequisites itself. The use of this technique led to a strict sequencing of educational materials which made the use of the computer a natural device to aid in teaching lessons. A number of pieces of specialized hardware were created to teach specific domains. These were systems in which the designer had built in a sequence of chunks to describe the domain, and the machine acted as a presentation device to offer these chunks to the student. These systems scored better than books or other non-interactive media because they could test if a student had mastered a specific chunk before going on to the next one. If the student had not, then the system could return to the previous chunk and reteach it in a different way (providing the designer had built alternative material into the program) (Elsom-Cook, 1990).

As CAI evolved, it overcame the need for specialized hardware for each different domain. One computer could emulate any number of programmed learning machines, and generic software was produced to allow individuals who were not programmers to generate domain specific sequences (Elsom-Cook, 1990). The problem was that the computer was still acting as a presentation device for material which was provided by a human in exactly the form in which it would be seen by the pupil. The computer had no knowledge of the domain it was teaching, and could not distinguish between other domains. The computer could only be as effective as the foresight of the author permitted.

An ITS (also known as the Intelligent Computer Aided Instruction (ICAI) of the 1980's and 1990's), on the other hand conducts computer assisted instruction in which the machine

builds up a model of what the student is thinking and chooses instructional steps (e.g., hints, new problems, new pieces of information, questions) on the basis of this constantly trained model (Johnson, & Resnick, 1988). ITS in contrast to CAI, is generative and adaptive. Generative means that the system creates teaching materials and events as it progresses; it is not merely storing material prepared by someone else (Elsom-Cook, 1990). Adaptive means that the teaching interaction is adjusted, both in content and form, to the current needs and abilities of each pupil individually (Elsom-Cook, 1990). Again, the range of adaptations is not explicitly specified in advance (as it would be by offering multiple branches in CAI learning) but is decided by the tutoring system itself as the interaction progresses.

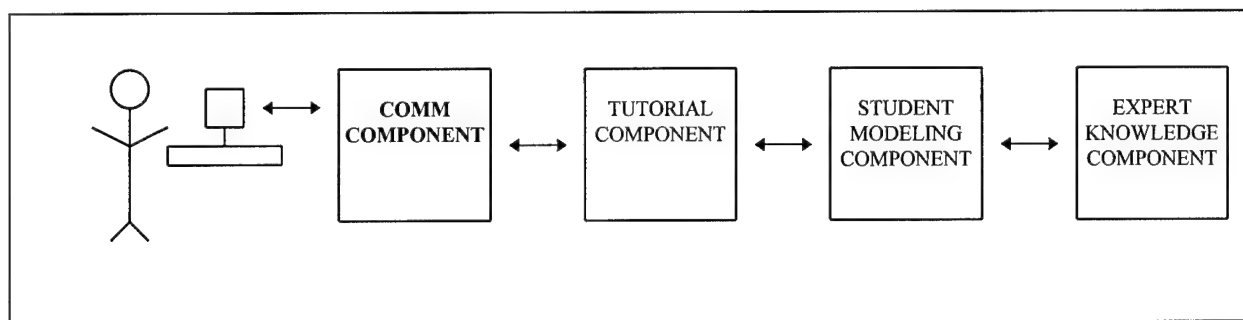
This flexibility is achieved by a process of abstraction in a tutoring system. Instead of providing the system with actual teaching materials, which intermingle domain knowledge, interaction knowledge, teaching strategies, assessment, etc., a tutoring system is provided with abstract descriptions of each of these components which it can combine to produce teaching material (Elsom-Cook, 1990). The system not only generates material but “knows” what it is doing and can hence reason about its effectiveness and adapt appropriately. The major differences between computer aided instruction and intelligent tutors are summarized in Figure 8 below.

<b>CAI</b>	<b>ITS</b>
Non-generative	Generative
Unadaptive	Adaptive
Not Flexible	Flexible

**Figure 8: CAI vs. ITS**

## Intelligent Tutoring System Architecture

Now that a detailed description of what an ITS is has been completed, the next step is to explain the general components that make up such a system. Coming up with a general architecture is easier said than done. The reason for this is that many ITS systems are built for a specific purpose using specific software. The concept of using shells is only now catching on with ITS systems. After a lot of literature review the varying architectures can be boiled down to four major components. The name of these components vary from source to source but the descriptions are generally the same. The four components (Figure 9) are the *expert knowledge component*, *student modeling component*, *tutorial planning component*, and *communication component* (Lesgold, & Mandl, 1988). Each component is described below.



**Figure 9: ITS Architecture**

### *The Expert Knowledge Component*

This component comprises the knowledge of experts: the facts and rules of a particular domain. Expert knowledge is represented in various ways, including semantic networks, frames, and production systems. It must include not only surface knowledge, but also the representational ability that is a critical part of expertise: the ability to construct implicit representational understanding from explicit observations and other information. There are two

different ways in which expert knowledge can be represented in a tutor. In earlier tutors, the knowledge was present only in “black box” form, which remained opaque to the learner (Lesgold, & Mandl, 1988). For example, the SOPHIE I tutor could answer any question a learner posed about electrical measurement values for any point in a complex circuit (Brown, Burton, & Bell, 1975, Burton & Brown, 1979). However, because it used numerical simulation techniques to derive these test values, it could not explain to the learner why the values were as reported (Lesgold, & Mandl, 1988). Because such explanations are very important to the acquisition of expertise, more recent work has focused on “glass box models” whose knowledge is represented in a way that more directly matches human capability, giving richer possibilities for explanations to the learner (Lesgold, & Mandl, 1988).

#### *The Student Modeling Component*

This component refers to the dynamic representation of the emerging knowledge and skill of the student. This requires a diagnostic capability that can deduce the student’s knowledge from their interactions with the system as he tries to handle the educational tasks posed to him. This module is capable of actually solving problems in the domain. The goal is to use machine learning techniques (case-based reasoning, generalization, and specialization) to emulate the student’s novice-to-expert transition (<http://www.sri.com>). The model design should infer which learning methods the student has used to reach the current knowledge state by comparing the student’s solution trace to an expert solution and generate possible hypotheses about what misconceptions and errors the student has made. Uncertainty can be modeled using fuzzy

methods. The hope is to develop a model that will adapt to the student and provide individualized teaching (Yazdani, 1987).

### *Tutorial Planning Component*

This component designs and regulates instructional interactions with the student. It is closely linked to the student modeling component, using knowledge about the learner and its own tutorial goal structure to decide which instructional activities will be presented: hints to overcome performance impasse, advice and support, explanation, new material to be taught, different practice tasks, tests to confirm the student model, etc. (Lesgold & Mandl, 1988).

One important distinction among tutorial strategies is between didactic (being told) and discovery-oriented learning (learning from experience). The primary advantage of didactic approaches is that they are goal-oriented. All activity focuses on the system's instructional goals, because the system initiates and controls activity. In discovery environments, some students take a long time to make the discoveries that constitute the system's goals. Discovery environments is seen as having an advantage in that they allow new knowledge to be constructed in the student's terms (in terms of the concepts and capabilities the learner already possesses) from direct concrete experience. Microworlds are one approach to discovery learning. Some recent micorworld systems tend to "guide" the discovery process in an effort to increase the efficiency of discovery learning (Lesgolg & Mandl, 1988). The developer of the system must understand the problem domain and the objectives of the system in order to decide which tutorial approach to take.

### *Communication Component*

The fourth and final component of an ITS is the communication component. This component controls the interactions between the system and the student. For a variety of reasons ITS's primarily use graphical user interfaces (GUI). These interfaces provide greater concreteness in the information provided to the student, and make the interaction with the student more "user-friendly" by substituting pictures and pointing for text and typing. The ITS communicates with the student primarily via graphics, since computer recognition and generation of written and spoken language, though being perfected, are still inadequate. From a psychological viewpoint, this presents a problem, since there is a much richer body of research on verbal processing than on the perception of and interaction with graphics (Lesgold, & Mandl, 1988).

### **Enabling Technology for ACSC**

Now that an explanation of what an ITS is has been completed, the next step is to show why this technology is an enabler for the accomplishment of the goals/objectives in light of the expected future changes listed in Figure 7.

#### *Teach More Officers on an Individualized Basis*

An ITS will be able to reach more officers than the current human experts on the faculty. The current human expert is limited by the number of hours a day they can teach, the areas that they are an expert in and the actual number of experts an institution is able to afford. An ITS captures the knowledge of the expert and stores it on a PC's hard drive or on a network file server. Once this knowledge is captured it can be used by any student who has access to the

files. With the current technology infrastructure at ACSC, an expert system could be placed on the school's LAN and it can be easily accessed by each student from their seminar desk by using their issued lap top computer. In addition, outreach students who have access to the internet could obtain access to these systems through the ACSC web page. So, more officers would have expert instruction than currently possible.

The ITS will be able to provide more individualized instruction than even the current small seminar size does. The critical component which determines how well the ITS is able to provide individualized instruction is the student model. The newer student modeling programs are able to adapt to the student's learning style and present material to them based upon earlier student answers. These newer types of systems use a variety of machine learning techniques with fuzzy reasoning and degrees of knowledge granularity which allow true individualized instruction (<http://www.aries.edu>). So, with limitless "experts" available to teach to each student based upon their own learning style and ability, the goal of teaching all field grade officers on an individual basis is possible.

#### *Less Money Available, Less Time to Teach*

The cost to develop a robust ITS can be significant but, when compared to the overall cost savings it can provide to daily operations, an ITS becomes very affordable. ACSC's use of ITS technologies for delivery of instruction will reduce the amount of time needed to teach the same material, reduce costs and improve results. Studies demonstrate as much as 50 percent or more reduction in time needed to learn, compared to conventional delivery (Armstrong, Cureo & Jones, 1994). Digital Equipment Corporation reported saving 40 percent of training time by

using interactive training instead of traditional classroom teaching. The IBM marketing education division reported time savings of 40 percent (Wood, 1993).

IBM's experience is a prime example of how the ITS technology will reduce military costs and provide better results. IBM reported an overall savings of more than \$150 million per year, with much of the savings coming from 300,000 employees not traveling to receive their instruction (Wood, 1993). ACSC should see similar dramatic savings by eliminating much of the physical residency requirement for courses and thus eliminate much of the moving, dislocation, per diem, and other costs of students attending resident courses (Spacecast 2020, 1994). A curriculum that integrates ITS technology has the potential to train more military members, more effectively, for less.

#### *Distance Learning*

The distance learning portion of ACSC can take on increased importance as a result of the possible shortening of the residence course due to budgetary constraints and as a result of the requirement to teach all field grade officers. The problem with the current distance learning that occurs in Air Force PME is that there are no "experts" present to teach the class. Students take turns teaching lessons to other students located on the same base. The student leader most likely does not have the expertise to provide an in-depth understanding of the subject matter to the other students. In addition, the student leader does not have the professional training on how to instruct and adapt his/her teaching to individual students in the class. The use of an ITS would help overcome the shortcomings of the current outreach program. All that would have to be done is to send the ITS program to the student who could run it on his own personnel computer.

The ITS would provide an “expert” to every student no matter the location, and as already mentioned the system could adapt to the individual student’s learning needs. An infinite amount of copies could be made so that every field grade officer involved in the distant learning program could have their own expert teaching them.

### *Teach at the Application, Analysis, and Synthesis Levels of Learning*

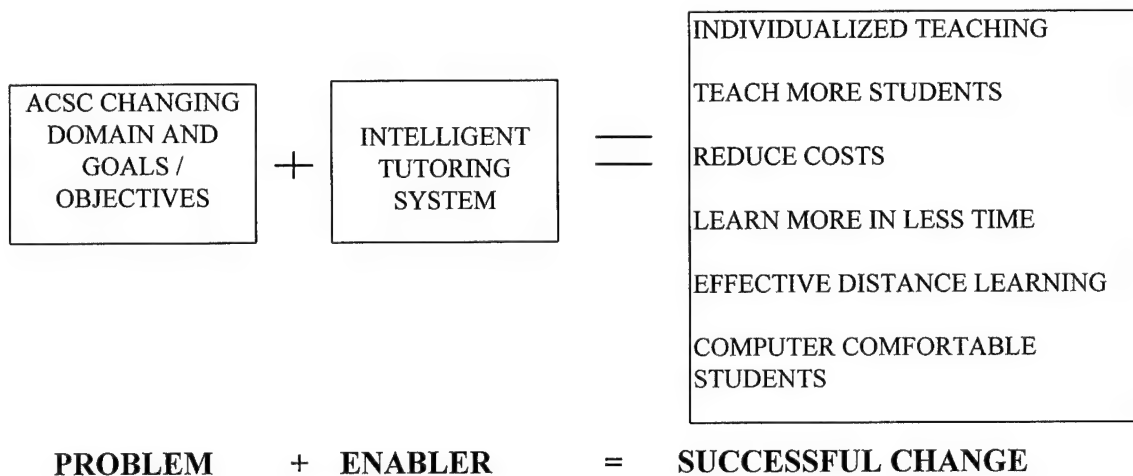
The important thing to remember is that the ITS will not totally replace other teaching methods. While it is a critical tool that would enable ACSC to reach many of its goals, this tool must be integrated into an overall comprehensive program in order for it to be effective. The curriculum must be developed in order to take advantage of the strong points of an ITS. The ITS will supplement classes and most likely be used during out of class time. The student can gain knowledge and comprehension levels of understanding of the subject matter and then use the valuable classroom time to build upon these concepts and take the level of learning to the application, analysis, and synthesis levels. In other words, an ITS is just one piece of the solution.

### *Making Students Computer Comfortable*

One of the ACSC goals is to make the students comfortable in operating computers in a networked environment. This goal could be accomplished by developing an ITS for that specific purpose. However, more likely the goal can be achieved just by requiring the use of an ITS in the curriculum. The way to teach a concept is by doing. By downloading the ITS from the LAN and using the ITS on their laptops the students will develop useful computer skills that they can use in any networked environment. So, just by integrating and using ITS technology (or any

computer technology) in the school's curriculum, students will be forced to learn basic computer skills.

ITS technology is an excellent tool to support and enable the accomplishment of the objectives and goals of the organization. By understanding the goals of the organization and the changing environment in which it expects to operate it is a fairly easy process to find a technology that will complement the organizational desires (see Figure 10).



**Figure 10: ITS an Enabler for Change**

However, deciding on the technology is one thing but implementing it is another.

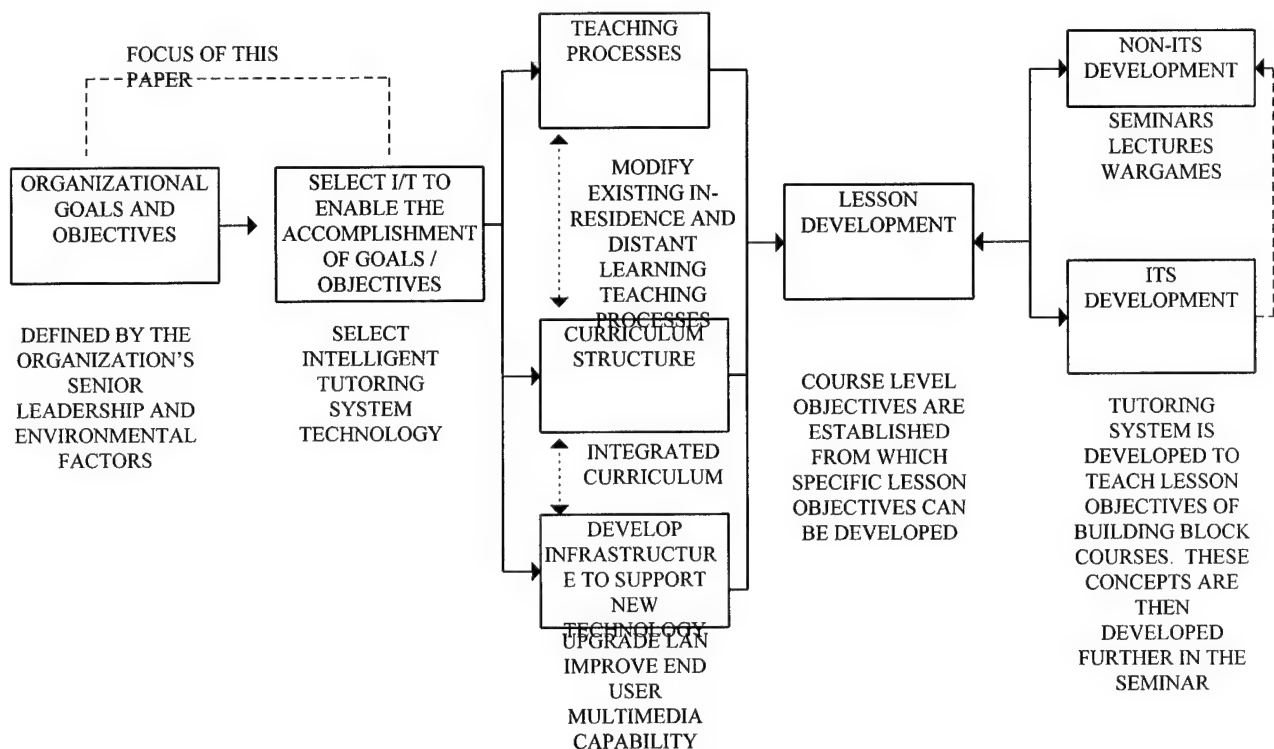
### **Recommendations for Implementation of an ITS at ACSC**

While the above discussion may lead one to believe that an ITS is an end to itself, it is far from it. As with most enabling technologies in order to make it effective, processes must be changed to unleash the true advantages. How these processes are changed and how well the technology is integrated with the change determines if the project will be successful. In the case of ACSC the current teaching process must be changed and smoothly integrated with the use of ITSs in order to reap the advantages of this technology. Glenda Scales (1996, p. 3) a professor in the College of Education at Virginia Polytechnic Institute states that

...the integration of computer-based technology into the educational process requires decisions-makers to rethink their opinions on several topics- for example their views on:

1. The role of the teacher in the classroom as well as their views on teaching and learning
2. The organization of student desks and computers in the classroom
3. The life-cycle and maintenance of computer hardware and software

As mentioned earlier, the important thing to remember is that ITSs will not totally replace other teaching methods. ITS it will supplement traditional methods, making the classroom time more effective. Figure 11 offers a methodology ACSC can follow in order to smoothly integrate and develop ITS technology. This methodology was developed using a variety of concepts. The concepts pertain to general systems theory, systems analysis and design practices, organizational reengineering and enterprise information architecture.



**Figure 11: Implementation Methodology**

### *Organizational Goals and Objectives:*

The methodology starts where everything should begin in an organization and that is with the overall goal and objectives. This concept has been an enduring theme throughout this paper and cannot be overemphasized. It is an obvious concept, but one that is many times ignored. The goals and objectives are defined by the senior leadership of the organization and are influenced by the environmental factors acting on the unit. In ACSC's case the goals and objectives are to develop independent, analytical, and creative thinking and apply the resultant abilities to the use of aerospace power. These goals and objectives are influenced by the perceived future environment of economic driven changes and changing Air Force requirements.

### *Select Appropriate I/T*

Once a clear vision is established by the senior leadership, the next step is to determine what type of I/T will enable the accomplishment of the goals and objectives. A team should be established to look at available technology that will realistically achieve the unit's goals and objectives. This team must be led by personnel from the teaching directorate with other members coming from the technology directorate. This step will most likely end up interacting with the first step.

Clarification of some of the goals may arise and some recommendations for the improvement to the wording may also occur as different types of technology and their capabilities are discovered. This interaction is expected and is healthy, as the more interaction, the more likely a suitable technology will be selected to achieve the organizational goals. It is critical that the senior leadership continue to be involved, not only in this step, but throughout the entire process. Also,

a champion must be identified and made a member of the team so that senior leadership support does not wane and team members stay motivated.

### *Restructured Teaching Processes*

Once the I/T is selected, the next step is to review and modify the teaching processes and the curriculum structure in order to take advantage of the technology. Even though some knowledge of the current teaching process is necessary in the selection of the I/T, it should not be an overriding factor at this point because it should not limit thinking. In other words you want to keep open minds in order to pick the best goals/technology match and not constrain thinking with how it will be implemented. This step should be accomplished by a team that is led by the teaching directorate with members also coming from the technology directorate(not necessarily by the same team members from the previous step).

### *Curriculum Structure*

ACSC operates an integrated curriculum. This means that early lessons in a block of instruction are used to introduce and teach important concepts that will be built upon throughout the block. These core concepts, once taught, will be used by the student in some type of application exercise in order to take the learning beyond knowledge and comprehension to the application, analysis, and synthesis levels of learning. This type of curriculum structure allows for the easy integration of the recommended ITS technology. Core concepts can be taught with the use of an ITS and then the same type of application exercise can be used to elevate the level of learning.

### *I/T Infrastructure Development*

Once the type of technology has been selected, then active effort must begin in the development of the I/T infrastructure that will support it. The development can range anywhere from minor modifications to complete redesign of the current architecture. In ACSC's case, at a bare minimum, modifications to the LAN to support high speed multimedia access and download will be needed, improvement in end user multimedia capability is needed, and application development software will need to be purchased if it is decided that the ITSs are going to be locally developed. This area needs further analysis.

### *Lesson Development*

Specific lessons must be developed within each block of instruction. This step is accomplished by the three teaching divisions that will be responsible for teaching the lessons. It is decided at this point exactly which lessons will be taught by an ITS and which lesson will be taught in a more traditional manner. The lessons that introduce core concepts are likely candidates of the use of ITS. At ACSC each block of instruction is required to have learning objectives defined and each lesson within that block of instruction must have specific learning objectives which support the block objectives. All of these objectives (Block and Lesson) should be defined at this point.

### *ITS Development*

The next step is to develop the ITS to teach the designated lessons and validate it against the lesson objectives and other block objectives. This is a critical step because a poorly developed

lesson will make all the prior planning and work mean nothing. The following must be taken into account when an ITS lesson is developed in order to make it effective; (Goff, 1996)

- Address a specific topic and be highly interactive
- The students must be able to control the experience
- Provide built-in feedback
- Offer hands on experience
- User focus not content focus
- User must feel that they are learning from someone who knows at least as much as they do

In addition who develops the program is an important question. The development of an effective, interactive, multimedia rich ITS is extremely time consuming and requires expertise in not only the subject matter but in the development software. If the proper amount of time is not taken in the development of the ITS then it will not be an effective tool and learning will suffer. Essentially a poorly developed ITS will achieve the same result as the current Toolbook applications at ACSC; most people will not use them. Currently at ACSC, the instructor who is developing the lesson plan for a subject is responsible for all the teaching material (learning objectives, teaching plan, video clips, Toolbook applications). This is one of the reasons most Toolbook applications used in the classroom are not as effective as they should be. The school has two possible choices for ITS development. First they could contract the development out to an agency that specializes in this type of technology. This is done quit frequently in the business world. The other option is to establish a division whose sole purpose is to use application development software to create the ITSs for the school's use. Software developed by LearnerFirst located in Birmingham, AL is very easy to learn and can be used to capture an expert's knowledge and effectively present it to any student (Wilson, 1996). This issue must be addressed in further detail by ACSC's senior leadership.

### *Non-ITS Lesson Development*

Traditional lessons can continue to be created by the instructor who has been designated responsible by the course chairman. One important thing to remember is that there must be interaction with ITS lesson development to ensure that each method is supporting the other.

## **CONCLUSION**

The purpose of this paper is to show how I/T can act as an enabler by the Air Force's Air Command and Staff College in order to accomplish its mission and accommodate change. Like any educational organization, ACSC will be facing many problems due to today's rapidly changing environment. The College needs to seek new ways to accomplish their mission faster, cheaper, and smarter. In other words, they need to break current paradigms and find new systems that will act as enablers in order to accomplish their mission not just more efficiently, but also more effectively. The school needs to shift its focus from primarily using I/T as a way to automate existing processes to developing an I/T plan that comes from, and thus supports, the unit's goals and objectives. Areas such as senior leadership commitment and support, operational leadership in the development of I/T plans, finding an I/T champion, effective I/T project leadership, and fostering a culture that nurtures the strategic use of I/T must be addressed if the successful merging of organizational and I/T strategies is to occur.

After analyzing the unit's goals and objectives in light of future environmental factors, it becomes apparent that ITS technology would strategically support the needs of the organization. ITS technology is a strategic enabler for ACSC. In order to ensure this technology lives up to its potential, careful planning resulting in effective implementation must occur. The methodology in Figure 10 is one way to ensure effective implementation occurs.

### **Areas for Future Research**

This paper should be used as the foundation for further efforts that are intended to strategically implement technology into the ACSC classroom. ACSC should form a team that

will expand upon the ideas presented in this paper. The team should validate the findings in this paper which are the first two steps in the implementation methodology. Once the concept is validated, the team should carry the implementation forward by completing the other steps of the methodology. The actual procedures used to accomplish each step should be documented and weaknesses in the methodology should be noted and improvements made so that a stronger implementation procedure can be used for future projects.

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## **APPENDIX A: I/T CAPABILITIES AT ACSC**

### Individual Resources:

#### Hardware

##### Faculty Workstations:

- Personal computer 486 or Pentium microprocessor
- Multimedia-CD-ROM and audio system
- SVGA color monitor - 14 or 17 inch
- Laptops - select user
- Laser printers - LAN Work area]
- Dot Matrix printers - one per Directorate
- Color Ink Jet printers - one per Directorate
- Color scanner - minimum of one per Directorate
- Fax machine - one per Directorate
- Copier - one per Directorate

##### Seminar Workstations:

- Personal computer - Pentium microprocessor
- Multimedia-CD-ROM and audio system
- SVGA color monitors - 17 and 25 inch video monitors
- Laser and Dot matrix printers
- Color scanner
- VCR player/recorder
- Overhead projector
- Fax machine - one per Division
- Copier - one per Division

##### Student Workstation:

- Laptop computer - 486 or Pentium microprocessor

#### Software:

- Microsoft DOS 6.22
- Microsoft Windows for Workgroups 3.11
- Microsoft Office Standard
  - Microsoft Word 6.0
  - Microsoft PowerPoint 4.0
  - Microsoft Excel 5.0
- Banyan Vines - Network Operating System
- Beyond Mail - E-mail
- Internet Explorer Browser
- On-Time Scheduler
- TCP/IP

ThunderByte Anti-Virus Utilities  
Multimedia ToolBook 3.0a  
Word Perfect 6.0 - selected users  
Corel Draw - selected users  
Hyper Write - selected users  
PerForm Pro for Windows - selected users  
FormFlow for Windows - selected users  
Microsoft Access - selected users

Centrally Managed Resources:

Hardware:

486 66-MHz File Servers  
486 PC Auxiliary Servers  
CD-ROM Towers  
Uninterruptable Power Supplies  
3B-2 Mini Computer  
CD-ROM Cutter

Software:

Banyan Vines - Network Operating System  
Beyond Mail - E-mail  
On-Time - Scheduler  
PerForm Pro for Windows  
FormFlow for Windows

ACSC complies with the AU technology upgrade/replacement cycle:

3 years for network servers and laptops  
5 years for desk top systems and printers  
7 years for audio-visual equipment

## APPENDIX B: NETWORK DESCRIPTION

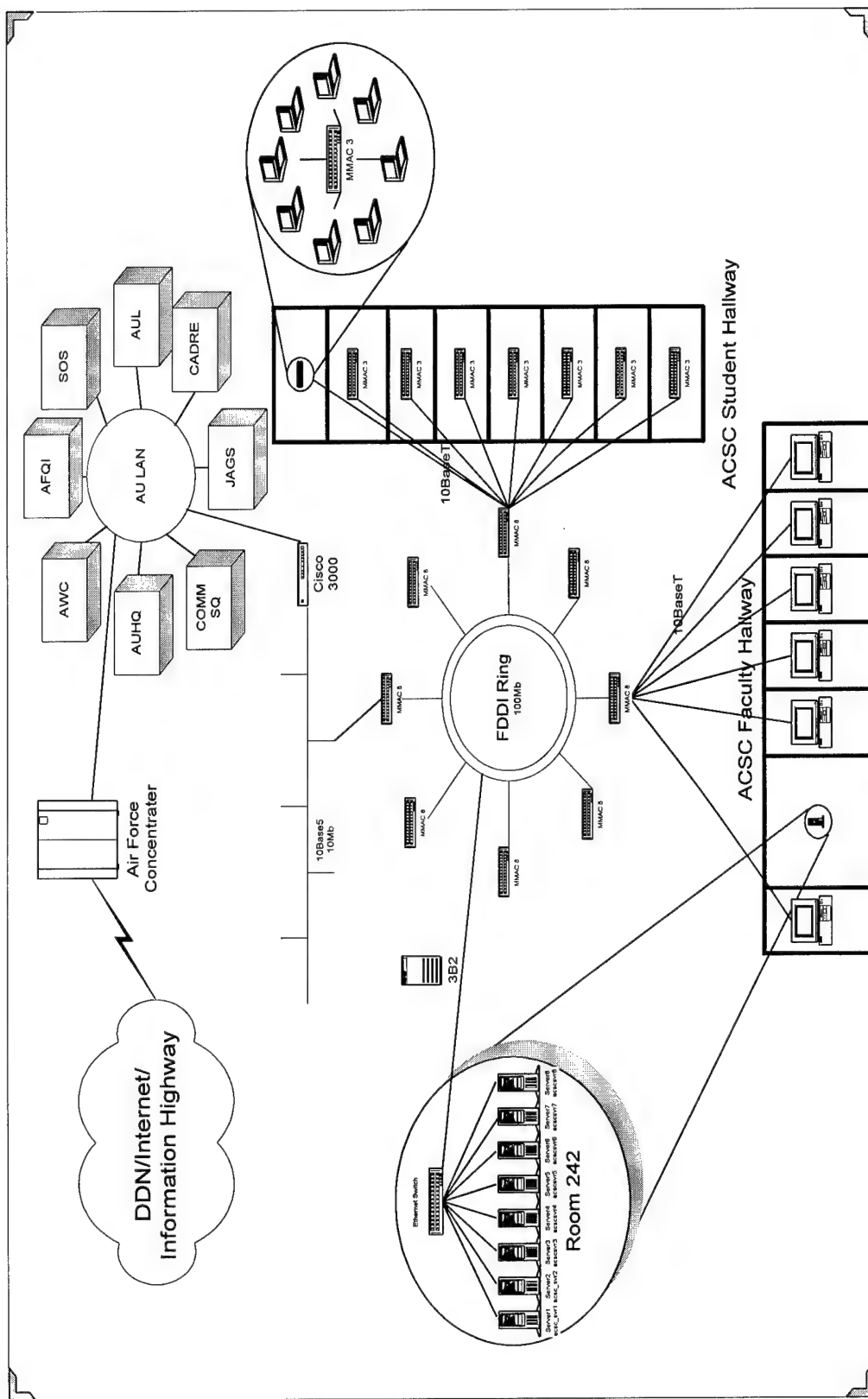


Figure 12: Network Diagram

## **Hardware Configuration**

ACSC has 8 (Network Operating System) NOS servers, located in a central office which are used to process the logins, file sharing, printing, remote dial-in / dial-out and the myriad of services requested by LAN users. The 8 servers spread the "load" of network users across multiple processors. Each server has 32M of RAM and three hard drives. One 500M hard drive is for the NOS, a second 500M hard drive and a 2.1G hard drive is for storage. The 8 servers connect directly to the Fiber ring backbone (FDDI) via an ethernet switch. In addition to the main network servers, ACSC has dedicated PCs running software packages for specific services offered on the LAN. Another PC runs the Bulletin Board. The Bulletin board provides a central location for LAN users to share and retrieve data. In addition the school has two CD-ROM towers also controlled by separate computers. The CD towers house up to 7 CDs and allow up to 95 simultaneous connections per CD. The Fax service allows LAN users to send and receive faxes directly from their computer without ever generating a paper copy. It too has its own computer. Finally, yet another PC controls network diagnostics and monitoring. This computer allows the network managers to check the status of all major components on the LAN such as Fiber optic cards, bridges, routers and hubs. UPS (Un-interruptable Power Supplies) which also act as surge protectors power all computers (including the servers).

ACSC's LAN consists of 10BaseT ethernet segments fed into one of the eight Cabletron MMAC8 hubs. All faculty PCs are connected directly to the MMAC8s. Each MMAC8 hub has a redundant power supply, a high speed back-plane, and slots for up to 8 network cards. The card slots give flexibility to add different functions to the network. Each MMAC contains at least

3 standard cards: a FDMIM, TPRMIM-36, and a EMME. Each card performs a critical function for the network. The EMME or bridging card is the controlling brain of the hub. It makes sure that each packet of information goes to its proper destination. The TPRMIMs are the outlets for all the actual computer connections. Finally the FDMIMs are the Fiber Optic cards that connect the hubs to one another. Again the hubs are connected via the (FDDI). Each of ACSC's 44 seminar rooms contain a MMAC3 which allows all students (13 to 15) to share a single 10BaseT connection to the hosting MMAC8. This hub can accept up to 3 network cards, and typically has an EMME card and a TPMIM-24. In addition to the 10BaseT network ACSC has in place a large 10Base5 (Thicknet) backbone which is connected to the rest of the LAN at one of the MMAC8 hubs. Each seminar room has a multi-media Pentium 100 desktop computer used for classroom presentations. These desktop computers are connected to the 10Base5 backbone.

The link to the outside world is controlled by a Cisco 3000 router.. Routers allow communication with the outside world and also serve the purpose of "screening" the network from superfluous information packets. This router is attached to the 10Base5 network and then to the Air University (AU) Fiber ring. Other organizations on Maxwell are connected to this ring. The AU ring is connected via a T-1 line to the Air Force concentrator at Gunter AFB also located in Montgomery. The concentrator is connected to the Defense Data Network (DDN) and this allows ACSC's faculty and students' access to off base organizations and the internet.

## **Software**

The NOS software used is Banyan-Vines. This software's popularity has increased dramatically in the past year. According to the network manager, on networks with 50 nodes or greater it controls 50% of the market. The reason for this popularity is its effective Street Talk Directory.

# AUBURN UNIVERSITY

STUDENT'S GRADE  
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QUARTER

040-50-7631

FALL

1995

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36849-5146

COURSE TITLE	DEPT. AND COURSE NO.	HRS. ATTEMPTED	GRADE	HOURS PASSED	GRADE POINTS	CLASS & CURR.
NGT BUS DATA COMMU	MN 602	3	A	3	20	GRADUATE A - SUPERIOR 4 POINTS/HOUR AU - AUDIT 0 POINTS/HOUR B - GOOD 3 POINTS/HOUR C - ACCEPTABLE 2 POINTS/HOUR D - PASSING 1 POINT/HOUR F - FAILURE 0 POINT/HOUR FA - FAILURE FOR ABSENCES 0 POINT/HOUR IN - INCOMPLETE 0 POINT/HOUR NG - NON-GRADED COURSE 0 POINT/HOUR NR - NO GRADE REPORTED 0 POINT/HOUR S - SATISFACTORY 0 POINT/HOUR U - UNSATISFACTORY 0 POINT/HOUR W - WITHDRAWN PASSING 0 POINT/HOUR WF - WITHDRAWN FAILING 0 POINT/HOUR X - ABSENT EXAMINATION, 0 POINT/HOUR F - FAILING 0 POINT/HOUR XF - ABSENT EXAMINATION, 0 POINT/HOUR TO COMPUTE GRADE AVERAGE SUBTRACT S C U HOURS FROM HOURS ATTEMPTED AND DIVIDE REMAINDER INTO GRADE POINTS. * All Hours Attempted at Auburn Plus all College Level Hours Approved from other Colleges and Universities
ADV DATA BASE MGT	MN 683	3	A	3	20	
INFO RESOURCE MGT	MN 689	3	A	3	20	
GRADE POINT AVERAGE						TOTALS
						* HOURS
						U GRADED HOURS
						S GRADED HOURS
						HOURS FAILED
						HOURS DEFERRED
						GRADE POINTS
						HOURS PASSED
						HOURS ATTEMPTED
						QUARTER
						CUMULATIVE TO DATE

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COURSE TITLE	DEPT. AND COURSE NO.	HRS. ATTEMPTED	GRADE	HOURS PASSED	GRADE POINTS	CLASS & CURR.
GLOBAL INF TEC MGT	EN 638	3	A	3	20	<b>GRADING SYSTEM</b> A - SUPERIOR 4 POINTS/HOUR AU - AUDIT 0 POINTS/HOUR B - GOOD 3 POINTS/HOUR C - ACCEPTABLE 2 POINTS/HOUR D - PASSING 1 POINT/HOUR F - FAILURE 0 POINT/HOUR FA - FAILURE FOR ABSENCES 0 POINT/HOUR IN - INCOMPLETE 0 POINT/HOUR NG - NON-GRADED COURSE 0 POINT/HOUR NR - NO GRADE REPORTED 0 POINT/HOUR S - SATISFACTORY 0 POINT/HOUR U - UNSATISFACTORY 0 POINT/HOUR W - WITHDRAWN PASSING 0 POINT/HOUR WF - WITHDRAWN FAILING 0 POINT/HOUR X - ABSENT EXAMINATION, 0 POINT/HOUR PASSING XF - ABSENT EXAMINATION, 0 POINT/HOUR FAILING TO COMPUTE GRADE AVERAGE SUBTRACT S OR U HOURS FROM HOURS ATTEMPTED AND DIVIDE REMAINDER INTO GRADE POINTS. * All Hours Attempted at Auburn Plus all College Level Hours Approved from other Colleges and Universities
INFO SYS ANALYSIS DES	EN 666	3	A	3	20	
GRADE POINT AVERAGE						<b>TOTALS</b> * HOURS U GRADED HOURS S GRADED HOURS HOURS FAILED HOURS DEFERRED GRADE POINTS HOURS PASSED
						<b>QUARTER</b> <b>CUMULATIVE TO DATE</b>

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COURSE TITLE	DEPT. AND COURSE NO.	HRS. ATTEMPTED	GRADE	HOURS PASSED	GRADE POINTS	CLASS & CURR.
SURVY CUR TECH M15 MGT END USER COMPU	MN 560 MN 614	5 5	A A	5 5	20 20	0- ALL A
<p>GRADING SYSTEM</p> <p>A - SUPERIOR 4 POINTS/HOUR</p> <p>AU - AUDIT 0 POINTS/HOUR</p> <p>B - GOOD 3 POINTS/HOUR</p> <p>C - ACCEPTABLE 2 POINTS/HOUR</p> <p>D - PASSING 1 POINTS/HOUR</p> <p>F - FAILURE 0 POINTS/HOUR</p> <p>FA - FAILURE FOR ABSENCES 0 POINTS/HOUR</p> <p>IN - INCOMPLETE 0 POINTS/HOUR</p> <p>NG - NON-GRADED COURSE 0 POINTS/HOUR</p> <p>NR - NO GRADE REPORTED 0 POINTS/HOUR</p> <p>S - SATISFACTORY 0 POINTS/HOUR</p> <p>U - UNSATISFACTORY 0 POINTS/HOUR</p> <p>WF - WITHDRAWN PASSING 0 POINTS/HOUR</p> <p>WF - WITHDRAWN FAILING 0 POINTS/HOUR</p> <p>X - ABSENT EXAMINATION, PASSING 0 POINTS/HOUR</p> <p>XF - ABSENT EXAMINATION, FAILING 0 POINTS/HOUR</p> <p>TO COMPUTE GRADE AVERAGE SUBTRACT S OR U HOURS FROM HOURS ATTEMPTED AND DIVIDE REMAINDER INTO GRADE POINTS.</p> <p>* All Hours Attempted at Auburn Plus all College Level Hours Approved from other Colleges and Universities.</p>						
GRADE POINT AVERAGE						TOTALS
						* HOURS
						U GRADED HOURS
						S GRADED HOURS
						HOURS FAILED
						HOURS DEFERRED
						GRADE POINTS
						HOURS PASSED
						HOURS ATTEMPTED
						QUARTER
						CUMULATIVE TO DATE

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20

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STUDENT'S GRADE REPORT

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QUARTER

SUMMER 1995

C40-52-7601

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AUBURN UNIVERSITY, AL  
36849-5146

COURSE TITLE		DEPT. AND COURSE NO.	HRS. ATTEMPTED	GRADE	HOURS PASSED	GRADE POINTS	CLASS & CURR.
EXPERT SYS FOR BUS		MN 667		A	5	20	GRADUATE
GRADE POINT AVERAGE	HOURS ATTEMPTED	HOURS PASSED	GRADE POINTS	HOURS DEFERRED	HOURS FAILED	S GRADED HOURS	U GRADED HOURS
TOTALS							* HOURS
							QUARTER
							CUMULATIVE TO DATE

GRADING SYSTEM

A - SUPERIOR 4 POINTS/HOUR

AU - AUDIT 0 POINTS/HOUR

B - GOOD 3 POINTS/HOUR

C - ACCEPTABLE 2 POINTS/HOUR

D - PASSING 1 POINT/HOUR

F - FAILURE FOR ABSENCES 0 POINT/HOUR

FA - FAILURE FOR ABSENCES 0 POINT/HOUR

NR - NO GRADE COURSE 0 POINT/HOUR

NG - NO GRADE REPORTED 0 POINT/HOUR

S - SATISFACTORY 0 POINT/HOUR

U - UNSATISFACTORY 0 POINT/HOUR

WF - WITHDRAWN PASSING 0 POINT/HOUR

X - ABSENT EXAMINATION, PASSING 0 POINT/HOUR

XF - ABSENT EXAMINATION, FAILING 0 POINT/HOUR

TO COMPUTE GRADE AVERAGE SUBTRACT S ON U HOURS FROM HOURS ATTEMPTED AND DIVIDE REMAINDER INTO GRADE POINTS.

\* All Hours Attempted at Auburn Plus all College Level Hours Approved from other Colleges and Universities

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## STUDENT'S GRADE REPORT

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COURSE TITLE	DEPT. AND COURSE NO.	HRS. ATTEMPTED	GRADE	HOURS PASSED	GRADE POINTS	CLASS & CURR.	06 MIS
ADV MGT INFO SYS SPECIAL PROBLEMS	MN 698 MN 690	5 5	A A	5 5	20 20	GRADUATE GRADING SYSTEM A - SUPERIOR 4 POINTS/HOUR AU - AUDIT 0 POINTS/HOUR B - GOOD 3 POINTS/HOUR C - ACCEPTABLE 2 POINTS/HOUR D - PASSING 1 POINTS/HOUR F - FAILURE 0 POINTS/HOUR FA - FAILURE FOR ABSENCES 0 POINTS/HOUR IN - INCOMPLETE 0 POINTS/HOUR NG - NON-GRADED COURSE 0 POINTS/HOUR NR - NO GRADE REPORTED 0 POINTS/HOUR S - SATISFACTORY 0 POINTS/HOUR U - UNSATISFACTORY 0 POINTS/HOUR WF - WITHDRAWN PASSING 0 POINTS/HOUR X - ABSENT EXAMINATION, PASSING 0 POINTS/HOUR XF - ABSENT EXAMINATION, FAILING 0 POINTS/HOUR TO COMPUTE GRADE AVERAGE SUBTRACT S, OR U HOURS FROM HOURS ATTEMPTED AND DIVIDE REMAINDER INTO GRADE POINTS * All Hours Attempted at Auburn Plus at College Level Hours Approved from other Colleges and Universities	
GRADE POINT AVERAGE						HOURS	TOTALS
						U GRADED HOURS	
						S GRADED HOURS	
						HOURS FAILED	
						HOURS DEFERRED	
						GRADE POINTS	
						HOURS PASSED	
						HOURS ATTEMPTED	
						QUARTER	
						CUMULATIVE TO DATE	

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